CLAIMS:

1. An evanescent wave cavity-based optical sensor, the sensor comprising:

an optical cavity formed by a pair of highly reflective surfaces such that light within said cavity makes a plurality of passes between said surfaces, an optical path between said surfaces including a reflection from a totally internally reflecting (TIR) surface, said reflection from said TIR surface generating an evanescent wave to provide a sensing function;

a light source to inject light into said cavity; and

a detector to detect a light level within said cavity; and

wherein said TIR surface is provided with a functionalising material over at least part of said TIR surface such that said evanescent wave interacts with said material;

whereby an interaction between said functionalising material and a target to be sensed is detectable as a change in absorption of said evanescent wave.

2. An evanescent wave cavity ring-down sensor comprising:

a ring-down optical cavity including an attenuated total-internal-reflection (ATIR) based sensing device for sensing a substance modifying a ring-down characteristic of the cavity;

a continuous wave light source for exciting said cavity; and

a detector for monitoring said ring-down characteristic; and

wherein said sensing device includes an ATIR interface to which is attached a material which has a selective response to a target such that an evanescent wave at said interface is modified by said target to modify said cavity ring-down characteristic.

3. A sensor as claimed in claim 1 or 2 wherein a portion of said TIR surface or interface to which said material is attached has substantially no features with a dimension perpendicular to said surface of greater than 3μm.

4. A sensor as claimed in claim 3 wherein said TIR surface or interface portion has substantially no features with a dimension perpendicular to said surface or interface of greater than 1μm.

5. A sensor as claimed in any preceding claim wherein said light source is configured to inject light into said cavity at an operating wavelength of said sensor, and wherein a portion of said TIR surface or interface to which said material is attached has substantially no features with a dimension perpendicular to said surface or interface of greater than twice said operating wavelength.

6. A sensor as claimed in claim 5 wherein an optical loss of said cavity at said operating wavelength in the substantial absence of said target is less than 1 percent, preferably less than 0.1 percent.

7. A sensor as claimed in any one of claims 1 to 6 wherein said material includes a tether or link to attach the material to said surface or interface.

8. A sensor as claimed in claim 7 wherein said TIR surface or interface comprises silica, and said tether comprises a silanol group.

9. A sensor as claimed in any one of claims 1 to 8 wherein said material provides no more than substantially monolayer coverage of said TIR surface or interface.

10. A sensor as claimed in claim 9 wheren said material provides fractional monolayer coverage of said TIR surface or interface, in particular wherein said fractional coverage is less than 10^{-1}, preferably less than 10^{-2}.

11. A sensor as claimed in any one of claims 1 to 10 wherein said material is directly attached to said TIR surface or interface.

12. A sensor as claimed in any one of claims 1 to 11 wherein said material only partially covers said TIR surface or interface, and wherein parts of said TIR surface or interface not covered by said material are passivated.

13. A sensor as claimed in any preceding claim wherein said material comprises a molecular material.

14. A sensor as claimed in any preceding claim wherein said material includes a chromophore.

15. A sensor as claimed in any one of claims 1 to 14 wherein said material comprises a host for a guest species or ligand.

16. A sensor as claimed in any one of claims 1 to 15 wherein said material comprises a crown ether or derivative thereof.

17. A sensor as claimed in any one of claims 1 to 15 wherein said material includes a protein.

18. A sensor as claimed in any one of claims 1 to 15 wherein said material includes a monoclonal or polyclonal antibody.

19. A sensor as claimed in any one of claims 1 to 15 wherein said material comprises DNA or RNA attached to said TIR surface or interface by one or more complementary base pairs.

20. A sensor as claimed in any preceding claim wherein said optical cavity comprises a fibre optic sensor configured to provide an evanescent field from light guided within the cable to said material for said sensing.

21. An optical cavity as recited in any preceding claim.

22. A sensor for a cavity of an evanescent-wave cavity ring down device, the sensor comprising a fibre optic cable having a core configured to guide light down the fibre surrounded by an outer cladding of lower refractive index than the core, wherein a sensing portion of the fibre optic cable is configured have a reduced thickness cladding provided with a functionalising material which has a selective response to a target such that an evanescent wave from said guided light interacts with said material and is modified by the presence of said target.

23. A sensor as claimed in claim 22 wherein said sensing portion of said fibre optic cable to which said functionalising material is attached has substantially no features with a dimension perpendicular to a surface of said sensing portion of greater than 3μm.

24. A sensor as claimed in claim 22 or 23 wheren said functionalising material provides no more than substantially monolayer coverage of said sensing portion of said fibre optic cable.

25. A sensor as claimed in claim 22, 23 or 24 wherien said sensing portion of said fibre optic cable is only partially covered by said functionalising material, and wherein parts of said sensing portion not covered by said functionalising material are passivated.

26. A sensor as claimed in any one of claims 22 to 25 wherein said functionalising material includes a tether or link to attach the material to said sensing portion of said fibre optic.

27. An optical cavity-based sensing device comprising:

an optical cavity absorption sensor comprising an optical cavity formed by a pair of reflecting surfaces;

a light source for providing light to couple into said cavity; and

a light detector for detecting a level of light escaping from said cavity;

wherein said optical cavity includes a sensing device comprising a functionalised optical interface, said optical interface being provided with a material which has a selective response to a target; and

wheren said functionalised optical interface is configured to substantially inhibit scatter of said light.

28. An optical cavity-based gas-phase sensing device comprising:

an optical cavity absorption sensor comprising an optical cavity formed by a pair of reflecting surfaces;

a light source for providing light to couple into said cavity; and

a light detector for detecting a level of light escaping from said cavity;

wherein said optical cavity includes a sensing device comprising a functionalised optical interface, said optical interface being provided with a solvating medium to convert a gas-phase target to a solution at said interface.

29. An evanescent wave optical sensing device, the device having a light input and a light output and being configured to provide an optical path between said light input and said light output, said optical path including a totally internally reflecting (TIR) optical interface for attenuated TIR-based sensing, and wherein said TIR interface is provided with a functionalising material which has a selective response to a target such that an evanescent wave at said interface is modified by the presence of said target; and wherein a portion of said interface bearing said functionalising material has substantially no features with a dimension perpendicular to said surface or interface of greater than 3μm.

30. An evanescent wave optical sensing device as claimed in claim 29 wherein said optical path further includes at least one reflecting surface such that said optical path includes two reflections from said TIR optical interface.

31. An evanescent wave optical sensing device as claimed in claim 30 wherein said optical path further includes two reflecting surfaces defining an optical cavity.

32. An optical charge/capacitance sensor for providing an optical signal responsive to charge and/or capacitance at an optical interface, said sensor comprising a light input and a light output and being configured to provide an optical path between said light input and said light output, said optical path including a totally internally reflecting (TIR) optical interface for attenuated TIR-based sensing, said TIR interface being treated such that a change in charge and/or capacitance at said interface causes a change in absorbance of light travelling between said light input and said light output.

33. A sensor as claimed in claim 32 wherein said interface treatment comprises partially providing said interface with light absorbing molecules.

34. A sensor as claimed in claim 32 or 33 wherein said interface comprises a silica interface.

35. A method of refreshing an interface to which is attached a material which has a selective response to a target, the method comprising:

providing said interface with a photoelectron generator; and

illuminating said photoelectron generator to release electrons to refresh said interface.

36. A sensing device including an interface to which is attached a material which has a selective response to a target, and wherein said interface is further provided with a photoelectron generator to assist in refreshing said interface.

37. A sensing device including an interface to which is attached a material which has a selective response to a target, said device further comprising a partition configured to allow selective transport of entities via said partition to and/or from said interface.

38. A sensing device as claimed in claim 37 wherein said partition is configured for application of a charge and/or potential to control said selective transport, in particular to refresh said interface.

39. A sensing device as claimed in claim 37 or 38 wherein said entities are electrically charged.

40. A sensing device as claimed in claim 36, 37, 38 or 39 wherein said interface is an optical interface, such that an evanescent wave at said interface is modified by said target.

41. A sensor, cavity or sensing device as recited in any preceding claim wherein said material functionalising said surface or interface comprises two components, one with an affinity or attraction for the target and a second to facilitate interaction with said evanescent wave.